Case Docket 9492

COMPOUND HANDLING SYSTEM

Cross Reference to Related Application

This is a continuation of copending patent Application No. 09/156,074, filed September 17, 1998.

Background of the Invention

1. Field

The subject invention relates to a system for handling a multiplicity of chemical or biochemical compounds or samples.

2. Description

In pharmaceutical research, chemical or biochemical compounds are routinely screened for their potential activity. Hundreds or thousands of small-volume, compound-containing samples ("aliquots") must be screened in the shortest time possible. Presently, aliquots are pipetted on demand from reservoir containers in which individual compounds are stored.

Compound-containing samples are oftentimes deep frozen for long term storage, thus necessitating that the samples be thawed for aliquot pipetting and then refrozen. Unfortunately, this procedure is cumbersome and time consuming. Moreover, frequent freezing and thawing cycles may result in compound deterioration, and reiterated pipetting may lead to contamination of the compounds. In each case, valuable and expensive compounds may have to be phased out and/or replaced before the entire quantity has been used. This wasting of compounds may represent a substantial economic loss.

It is the aim of the present invention to provide a compound handling system which is not afflicted with these disadvantages.

Summary of the Invention

The subject invention provides a system for handling a multiplicity of tubes that each contain an aliquot of a chemical or biological sample. The system comprises a rack, means for inserting a tube into a storage compartment, and means for removing a tube from a storage compartment. The rack holds a multiplicity of tubes, and has a top side and a bottom side and storage compartments. Each storage compartment is configured and dimensioned to receive a tube containing a chemical or biological sample, and is open at the top side of the rack and open at the bottom side of the rack so that a tube can be inserted into the storage compartment from either the top side of the rack or the bottom side of the rack and can be removed from the storage compartment from either the top side of the rack or the bottom side of the rack.

Brief Description of the Figures

Preferred embodiments of the invention are described with reference to the accompanying drawings.

Fig. 1 - a perspective view of a storage rack with containers in various typical positions

Fig. 2 - a crossectional view along line A-A in Fig. 1

Fig.3 - a more detailed view of a portion of Fig. 2

Fig. 4 - an inside view of a storage room

Fig. 5 - a perspective view of a transfer system for transferring individual containers from storage plates to transport plates.

Detailed Description of the Invention

The invention will now be described in terms of its preferred embodiments. These embodiments are set forth to aid in understanding the invention but are not limiting.

According to the invention, compound handling is achieved by a compound handling system which stores compounds in aliquotted form. Each aliquot is contained in a separate container, and the containers are arranged in racks. The racks have container holding spaces which are open at opposite ends to the effect that insertion of the containers into the racks and their removal therefrom can be effected in either direction of movement.

Advantageously, the rack with the inserted containers resembles the shape of a microtiter plate which can be handled by the conventional robots used in high throughput screening.

The storage plate or rack 1 shown in perspective representation in Fig.1 has a peripheral frame portion 2 for mechanical rigidity, and grid-like arrangement of separation walls 3 defining sixteen rows 4, each row 4 having twenty-four individual rectangular storage compartments 5. Collectively, these three hundred eighty-four (384) storage compartments are configured and dimensioned to hold an equal number of microtubes 6.

The storage compartments 5 are open at both ends, i.e. at the top surface and at the bottom surface of rack 1. The purpose of the two openings will be explained later in this specification.

Various groups of microtubes 6 are shown in Figures 1-3 in different positions relative to the rack 1. This situation is shown for demonstration purposes only and

does not represent a situation encountered during normal operation. In normal use, all the tubes belonging to one rack are in the same position which may be any one of those shown in Fig. 1.

Referring to the Figure 2 the first group of microtubes on the left side of the rack 1 is in the position prior to insertion of the tubes into the rack. Moving left in Figure 2, the second group of microtubes has been inserted in the rack 1 but only to a position where the upper rims of the tubes still project above the upper surface of the rack. This is the filling position in which aliquots of compounds are pipetted into the tubes. After the tubes have been filled, they remain in the same position for the next processing step, i.e. closing or sealing the tubes. All the tubes of a rack together are covered with an aluminum foil 7 (see the third group of tubes in Fig. 2) which is sealed, e.g. affixed onto the upper edges of the tube openings. The technology for this step is well known in the packaging art, e.g. from the closing of blister packs with aluminum foil.

These procedural steps, especially the filling and sealing, are preferably performed under sterile conditions or inert gas to avoid contamination of the compounds. Moreover, pipetting is preferably performed by pipetting systems having multiple pipettes that simultaneously fill the groups of tubes.

Moving further left in Fig. 2, the fourth group of tubes is shown after the foil has been punched around the upper edges of the tube openings. Also shown is the remainder 8 of the foil after punching. In the fifth group of tubes (shown at the right side of Fig. 2), the tubes are fully placed inside the storage compartment 5 (the fully inserted position). To move the tubes into this position they may be pushed down by a suitable stamp or piston after the foil has been punched. Alternatively, after affixing the foil, the tubes may be pushed upwards and entirely out of the rack into the punching tool, and afterwards reintroduced into the rack from below. This alternative allows safer separation of the foil without breakage.

In the fully inserted position, the tubes are stored in the rack 1 in a storage room under appropriate storage conditions such as low temperature, darkness etc. These storage conditions and the sterility during filling and sealing, permit the compounds to be stored for very long times without deterioration.

The tubes are made of a material which stays elastic at lower temperatures, such as -20 Celcius ("°C"). It has been found that polypropylene is suitable for this purpose.

Fig. 3 shows certain features of the tubes and the storage cavities for holding the tubes in place. The preferred tubes are provided with two parallel annular ridges 9 around the upper portion of their outside wall. The separation walls 3 defining the cavities 5 are provided with projections 10 extending parallel to and at a small distance below their upper edge. When the tubes are being fully inserted as shown for the group of tubes at the right of the rack, the projections 10 snap in between the two ridges 9. In this position, the tubes are safely held in their places.

The storage racks with the tubes containing the compound containing aliquots are stored in a cold room (shown in Fig. 4). The cold room is humidity-controlled and kept at a temperature of -20° centigrade. The cold room is equipped with vertical shelf partition walls 11 having support elements 12 extending therefrom. The support elements are provided with inclined upper edges 13 for the purpose of centering the racks 1 resting thereon.

Putting together a selection of compound aliquots according to certain selection criteria is effected in a transfer station 20 shown in Fig. 5. This transfer station is inside the storage room or in an area connected to it having the same temperature conditions. The compound selection is assembled on transport rack 21 placed in the station. The rack 21 may be of the same type as the storage racks 1 or could be of

different size. It is advantageous however that it has the same cavity pattern as the storage racks.

The transfer station contains conveying means for placing a storage rack 1 containing at least one tube with a desired compound aliquot in it on top of the transport rack. The two superposed racks are arranged such that the cavity containing the desired tube is in line with the transport rack cavity which is to receive the desired aliquot. In this relative position the tube is simply pushed from its storage position into the appropriate position in the transport rack.

Conveying means as well as electronic control means needed for the relative positioning of the two racks are well known in the art of automation as so-called X-Y movement or manipulator and need not be described here in detail.

The subject invention has been described in terms of its preferred embodiments. After reading the specification, other embodiments will become obvious to the skilled artisan. For example, the microtubes could be made of any number of suitable substances, including other polymers, such as polyethylene. The annular ridge-projection tube retaining system described above could also be replaced with a suitable tension fit or other biasing system to retain the microtubes in place. Accordingly, the subject invention should only be limited by the claims that follow and their equivalents.